

REMARKS

Favorable reconsideration and allowance of the present application are respectfully requested.

Prior to the above amendment, claims 3-31 were pending in the present application. Of these, claims 21-27 have been cancelled without prejudice to or disclaimer of the claimed subject matter. Applicant reserves the right to pursue these claims in a continuing application.

The Examiner indicated that claims 14-20 are allowable. Applicant is appreciative to the Examiner for the indication of allowable subject matter.

Claims 4-6 were objected to as being dependent upon a rejected base claim. The Examiner indicated, however, that these claims would be allowable if rewritten in independent form including all limitations of the base claim and any intervening claims.

By the above amendment, dependent claim 4 has been rewritten as an independent claim including all limitations of base claim 3. Claims 5 and 6 both depend directly from now-independent claim 4. It is thus submitted that claims 4-6 are also in condition for allowance.

Claims 3, 7-13 and 21-31 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Pat. No. 6,370,964 to Chang. As noted above, claims 21-27 have been cancelled without

prejudice. It is thus submitted that the rejection of these claims is moot. Regarding the other rejected claims, Applicant respectfully traverses.

Independent claim 3 relates to a system operative to detect a damage feature in a thin wall structure. The system comprises an array of piezoelectric wafer sensors embedded on the structure in a predetermined pattern. A generator is operative to excite at least one of the sensors to produce ultrasonic waves having a frequency of at least about 200KHz in the structure. A signal processor is operative to process received signals so as to detect the damage feature.

Significantly, independent claim 3 has been amended above to specify that the ultrasonic waves are tuned guided waves. In addition, claim 3 has been amended to specify that received signals evaluated by the signal processor are reflected from the damage feature and received at the same sensor from which the guided waves originated. As a result, the damage feature is detected via a pulse-echo technique. The use of guided waves of this type is advantageous because they stay confined inside the walls of the thin walled structure, and hence can travel over significant distances. Support for these amendments is provided, for example, in the discussion appearing on page 13, line 15 through page 15, line 15 of the present specification.

This is in contrast to the Chang reference applied in the

Office Action, which uses neither a pulse-echo technique nor tuned guided waves. Instead, Chang uses a technique wherein one transducer functions to generate a signal, which is then received at a different transducer. This is described in the Chang patent as follows:

Inputting a time-varying electrical signal to any one of actuators/sensors 14 causes a propagating stress wave or propagating mechanical deformation to emanate from the sensor/actuator 14 and travel through the material. A plurality of neighboring actuators/sensors 14 may then detect this propagating stress wave. The nature of the wave received by any given neighboring actuator/sensor 14 is a function of the spatial arrangement of that actuator/sensor 14 in relation to the actuator/sensor which emitted the wave.

Chang, col. 6, line 63 through col. 7, line 4. Accordingly, it is submitted that independent claim 3 and all claims dependent thereon are in condition for allowance.

The present application also describes (on page 5, line 18 through page 9, line 13) a technique whereby drive point impedance measurements can be taken at each sensor in order to detect changes in a sensing zone around that sensor. In other words, damage in the sensing zone will cause changes in the drive point impedance of the particular sensor. These changes will be reflected in the sensor's impedance spectrum. As a result, impedance measurements taken before and after occurrence of the damage feature can be utilized to detect its presence. Preferably, sensors in the array are arranged so that their impedance sensing zones will overlap.

This is reflected in independent claim 28, which relates to a method of detecting a damage feature in a thin wall structure. The method comprises providing at least one piezoelectric wafer sensor embedded on the structure. The sensor is excited with a first electrical signal in a predetermined frequency range. First data is thus derived which is characteristic of a drive-point impedance of the wafer sensor as embedded on the structure. The sensor is further excited with a second electrical signal spanning the predetermined frequency range. Second data characteristic of the drive-point impedance of the sensor is thus detected. The first data and the second data are then compared.

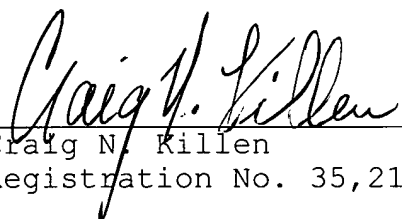
The undersigned has carefully reviewed the Chang reference and has found no teaching or suggestion therein to practice a method as set forth in independent claim 28. In this regard, the Office Action indicates that Chang discloses a comparison of two sets of data at column 14, lines 3-44. In reading this portion of the Chang reference, however, there is no indication that the data being compared reflects the drive-point impedance of a single sensor element. In fact, the referenced portion of Chang appears to describe a "pitch-catch" technique for performing diagnostics which relies on an entirely different physical principle. Accordingly, it is respectfully submitted that independent claim 28 and all claims dependent thereon are in condition for allowance.

Each of the dependent claims serve to further limit and define aspects of Applicant's inventive subject matter. Thus, in addition to the reasons presented above in relation to the independent claims, these claims are believed to be fully patentable in their respective combinations. For the sake of brevity, it is not believed necessary to discuss each of these dependent claims in detail at the present time.

Nevertheless, Applicant disagrees with a few of the statements made in the Office Action regarding the dependent claims. For example, Applicant submits that nothing in Chang teaches the use of ultrasonic waves having a frequency of greater than 250KHz. Nor does it disclose sensors having the specific dimensions set forth in several of Applicant's dependent claims. In this regard, the reference at column 13, lines 34-44 of Chang refers to the thickness of the dielectric layer supporting the piezoelectric sensors, not the dimensions of the sensors themselves. Moreover, Chang does not contemplate the use of Lamb waves (which may be due to the fact that the frequency band is relatively low (30-250 KHz)).

Based on the above, it is respectfully submitted that the present application, including claims 3-20 and 28-31, is in condition for allowance, and action to such effect is earnestly solicited. The Examiner is invited to telephone the undersigned should any minor issues remain after consideration of the above amendment.

Respectfully submitted,



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